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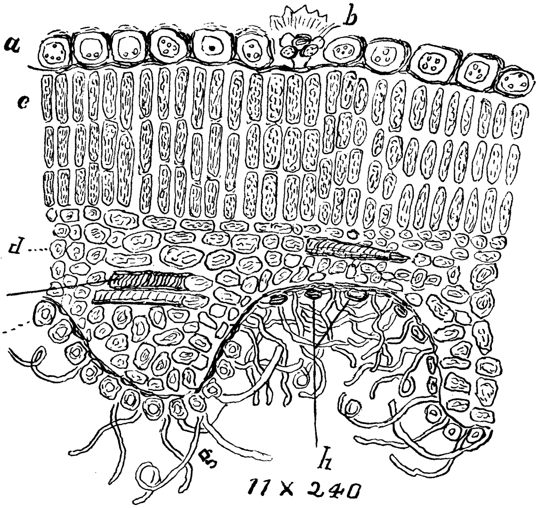

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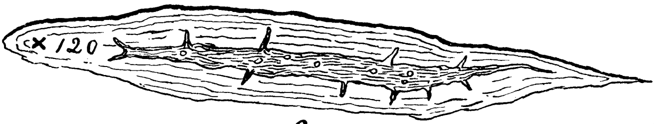

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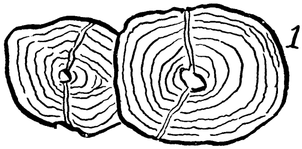

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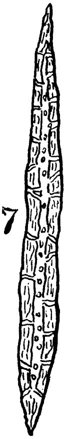

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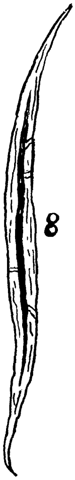

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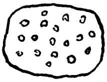

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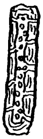

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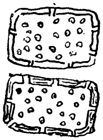

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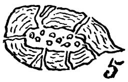

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ROTHROCK ON ERIODICTYON.

Eriodictyon glutinosum, Benth., as Illustrating Evolution.

(Plate II.)

As a teacher I have often been perplexed to answer the question of my pupils: why is it that to cells and tissues which so often shade into each other and which usually present such small differences you give distinct names? To the more advanced investigator, however, the problem comes in another shape, *i.e.* how is it that cells which start at first from a simple form of fundamental tissue eventually become so unlike? If the observer has allowed himself to philosophize over this question he most probably has learned to regard it as but another paragraph from the great chapter on evolution, and can hardly have escaped a wonder that cell variation is so little written or spoken of in this connection by botanists. Cell growth and development, whether rightly or wrongly, appear to have suffered a divorce from our ideas of specific evolution, yet the latter could not exist without the former. Simple parenchyma may be all sufficient for every form of thallus; but before a true caulome can rear its head into the air, there must be the differentiated, stiffening woody fibre; or before the hard-shelled nut could be produced, sclerenchyma must have appeared. Evidently then this differentiation has to do with success in the struggle for existence. But with all this, in the *great mass of plants* there appears to have come a settled average character in the different groups of cells and tissues; that is, differences marked enough exist, but we can read them through from the outside to the pith before ever a section has been made. On the other hand there are others which we have come to recognize as likely to show deviations from the regular order before we have examined them, though we cannot tell what directions those deviations will take. Some of these may serve to show evident connections between the different cell types in places where we hardly expected to find such links. I have recently been quite struck with this last class of facts in studying *Eriodictyon glutinosum* from the standpoint of practical pharmacy, though the facts themselves were entirely outside the objects I had in view, and have no bearing upon them. What I desire to call attention to here are simply gleanings which lay off, but alongside, the pharmaceutical trail.

A more striking instance of the connection between diverse forms of tissue can hardly be imagined than that furnished by the change from bast to sclerenchyma; the former being typically represented in the fibre which makes the napkins we use at the table, and the latter in the shell of the hickory nut which defies our youthful teeth. Yet figures 9 & 10 are taken from fibres in the Peruvian Bark which are so nearly on the boundary line that by some vegetable anatomists they are classed as bast and by others as sclerenchyma. Isolated in the pulp of pears are found the gritty grains of sclerenchyma, though from the same fundamental cells come both the soft and the hard tissues. In the case of the pear there are manifest reasons for supposing the sclerenchyma to be a legacy from the period when pears as fruit were far less luscious than now. They are found in the pear stem as well as in the fruit. In the fully formed Sphagnum moss we recognize cells of two distinct characters; the one large, colorless, and with plain communication between the adjacent cells; the other small, having chlorophyll and destitute of communications; yet, if we may credit Huxley, both of these kinds are very similar in their early growth.

To return to the *Eriodictyon*, the character of the tissues have appeared to me to indicate how widely ultimate cell forms may depart from the original source out of which they all have sprung, and at the same time to show connecting links between even the most divergent members. In fact I am tempted to regard the whole plant as a forcible illustration of the doctrine of evolution.

Commence for example with figure 1, where we have the typical large, thin-walled, porous pith-cell, found in the very center of the stem. Outside of this, but still in the pith, are other small er, thicker-walled cells, figure 2, which when observed on transverse section are roundish, but seen on longitudinal section are quite distinctly rectangular. More remote from the center of the pith, yet in it, we find the cells represented in figure 3; and this form is a direct transition to figure 4, which is taken from the medullary ray. Here then the transition, not by isolated cells, but by groups of cells, from one extreme of fundamental tissue to the other appears regular and gradual and ends in cells with well-marked sclerenchymatous character.

Suppose now we take the types of distinctly prosenchymatous character, which the bast zone of *Eriodictyon* furnishes. Figure 8 is the more usual form of bast found in other plants, though occasionally seen in *Eriodictyon*. Figure 7 will give us one of the commonest shapes of bast in *Eriodictyon*; and figure 6 represents a shorter kind often discovered in the bast and also throughout the woody part of the stem. Figure 5 may be called a representative sclerenchymatous cell, though it is found also in the bast zone. Here again we have four forms of cells which represent the transition from bast to sclerenchyma, and all in the same belt of the same plant.

The structure of the leaf of *Eriodictyon glutinosum* is even more suggestive. Figure 11 is a section through such a leaf. The first striking peculiarity is the thickness of the epidermal cells as shown by *a* and by *f*. This is particularly marked in *a*, the upper surface, where not only the thick walls of the cells but the pores in them remind one of figure 3, taken from the outer pith. This as being the more exposed surface would naturally show the denser tissue. The secreting gland, *b*, has no particular import in the present connection. Three rows (ordinarily) of palisade cells come next underneath the upper epidermis and appear to be special provision against excessive evaporation and are in entire keeping with the thick epidermis. They are thin-walled and contain abundance of chlorophyll, though probably less than the proper parenchymatous cells next below them. These last-named parenchymatous cells are, as might be expected, loose in their aggregation and show numerous open spaces which are in apparent relation to the admission and escape of atmosphere and the contained gases of the plant. The under surface of the leaf is raised into ridges or prominences between which in the cavities so formed the stomata (*h*) are placed under protection of numerous inflected and variously curled hairs (*g*). This mode of placing and protecting the stomata is by no means uncommon, being found also in the *Oleander*, in *Banksia*, and in *Ceanothus prostratus*, to say nothing of many other plants. Sometimes, at least, it is known tc be associated with dry habitats; often enough, at least, to suggest the inquiry as to whether it may not be to prevent stomata which occupy such cavities from becoming choked with dust or other foreign bodies. This raises the question as to the meaning, from the standpoint of evolution, of such elevations and depressions on the under surface of the leaf. So far as I am aware they are never seen except in hard-leaved plants, which leaves are also often further protected by a thick coating of hair. Is all this a mere trace remaining of what was once a more common structure, adapted to more variable or more inclement (hot or cold) climate, before the elevations were smoothed away and the hairs were rendered unnecessary by the more genial conditions of present snrroundings? This is simple conjecture on my part, but I cannot avoid thinking that it is not far from the truth.—DR. J. T. ROTHROCK.

EXPLANATION OF PLATE II.—*Eriodictyon glutinosum*, Benth.

Figure 1. Typical pith cell X 240, from central part of pith.
Figure 2. Typical pith cell X 240, from outer part of pith.
Figure 3. Less common form of pith cell X 240, from outer part of pith.
Figure 4. Isolated cell X 240, from medullary ray.
Figure 5. Sclerenchym cell X 240, found in the bast zone.
Figure 6. Longer sclerenchym cell X 240, found in bast zone, and also along with woody fibre in interior of stem, where it would be regarded as a thickened form of wood parenchyma.
Figure 7. Typical cell X 240, from bast zone.
Figure 8. More common form of bast cell as found in other plants.

Cinchona flava, though also occasionally in *Eriodictyon*.

Figure 9. Bast (or sclerenchym ?) cell X 120, longitudinal view.
Figure 10. Same X 240, transverse section.

Eriodictyon glutinosum, Benth.

Figure 11. Leaf section; *a*, epidermis of upper surface showing thick walls and pits; *b*, secreting gland backed by striated cuticle; *c*, palisade cells; *d*, parenchym cells; *f*, epidermis of lower surface; *g*, long hairs which guard the stomata (*h*) seated in a cavity on the under surface of the leaf.